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USE OF AVIATION 3-M INFORMATION OUTPUTS
BY
ORGANIZATIONAL MAINTENANCE USERS

by

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December, 1989

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Use Of Aviation 3-M Information Outputs
By
Organizational Maintenance Users

by

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ABSTRACT

This thesis presents the results of a study concerning the use of information outputs from the Aviation 3-M System by organizational level maintenance users. Specifically examined are Naval Aviation Maintenance Support Office (NAMSO) information reports, Naval Aviation Logistics Data Analysis (NALDA) information outputs, and squadron-generated monthly 3-M summaries. A survey using unstructured interviews with squadron data analysts and maintenance managers was conducted to investigate how the information outputs are meeting users' needs and in what capacity. A review of the Aviation 3-M System, the information products derived and results of the survey are provided. It is shown that such outputs have limited impact on decision making in organizational level maintenance due to the time lag of 3-M data.

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LIST OF ABBREVIATIONS

ASO	Aviation Supply Office
AWM	Awaiting Maintenance
BCM	Beyond Capability of Maintenance
CNO	Chief of Naval Operations
DSF	Data Services Facility
EOC	Equipment Operational Capability
FMC	Full-Mission-Capable
MDR	Maintenance Data Report
MDS	Maintenance Data System
3-M	Maintenance and Material Management
NALCOMIS	Naval Aviation Logistics Command Management Information System
NALDA	Naval Aviation Logistics Data Analysis
NAMSO	Naval Aviation Maintenance Support Office
NAVFLIR	Naval Flight Record
NMC	Non-Mission-Capable
PMC	Partial-Mission-Capable
PMS	Planned Maintenance System
QA	Quality Assurance
SCIR	Subsystem Capability Impact Reporting

I. INTRODUCTION

A. BACKGROUND

The aim of any information system is to serve the user, to make his or her job easier and to help improve the manager's performance [Ref. 1:p. 174]. The success of an information system depends on its ability to produce relevant information to assist managers in their decision making. The value that a manager places on the information is based on the individual's experience in making decisions with and without that information [Ref: 1:p. 20]. Thus, it might be assumed that the value of the information is equal to the positive effect it has on the manager's decisions.

However, it is not always possible to assess information in that way. Often, useful information may be hidden in a mass of irrelevant data. Sometimes, the required information can be found and used, but the sheer volume of information prevents effective use. Because of the costs and the time that would be involved to separate the data into useful information segments, an information system may simply produce all the information possible and leave it for the user to sort out. [Ref. 1:p. 20]

For an information system to be successful, it must be designed to operate in a constantly changing environment. Bentley [Ref. 1] stated five attributes for a system's success: flexibility, reliability, economy, simplicity and helpfulness. Flexibility is noted because a system should allow for changes in almost every

aspect, from data collection to the final information output. One area of change occurs in user needs [Ref. 1:p. 171].

One information system used by the Navy is the Aviation Maintenance and Material Management (3-M) System. The collection of aircraft operational, maintenance, and logistics support information and its distribution throughout the Navy aviation community has been an ongoing process in Naval Aviation Maintenance for almost 30 years [Ref. 2:p. 9]. The Aviation 3-M System was developed to meet those information needs by using standard procedures to collect specific data about maintenance and logistics efforts in the field. The goal of this information system was to provide timely and accurate information derived from processing of the aggregated data to support management of aviation activities [Ref. 2:p. 10].

At the present time, the databases of the Aviation 3-M System and another Navy information system, the Naval Aviation Logistics Data Analysis (NALDA) System, are in the process of being merged into one common database. Interest has been expressed by one of the organizations involved in the merger, the Aviation Supply Office, regarding the use of information outputs from the two present databases, how they are currently meeting user needs and in what capacity. This thesis will attempt to address the issue of user feedback from the viewpoint of organizational level maintenance in Navy aviation squadrons.

B. OBJECTIVES

This study examines the use of certain Aviation 3-M System information products at the organizational maintenance level, specifically:

- Aviation 3-M Information Reports from the Naval Aviation Maintenance Support Office (NAMSO).
- Information outputs from the Naval Aviation Logistics Data Analysis (NALDA) System.
- Squadron monthly 3-M summaries.

NAMSO serves as the central data base for aviation 3-M data and uses the 3-M data to produce reports that are widely distributed throughout the Navy, including aviation squadrons. The NALDA System uses 3-M data from NAMSO as a large part of its database. Use of the NALDA System was originally envisioned only for management use at the intermediate maintenance level and above [Ref. 3]. However, the installation of terminals at many of the Functional Wing commands now allows accessibility to NALDA information outputs by squadrons. Finally, the monthly 3-M summary produced by a squadron can draw its data from a variety of sources, including internal records of the squadron, reports from organizations such as NAMSO, the local data services facility, and an information system like NALDA.

The interest of this study in outputs from NAMSO and the NALDA System and their use centers on the following questions:

- Do current Aviation 3-M System products output by NAMSO and the NALDA System to the organizational level maintenance user at the squadron meet the intent of the 3-M system, which is supporting better management decisions?
- How are those products used by squadron maintenance and to what degree?

- To what extent is a squadron's internally generated monthly 3-M summary supported by the NAMSO and NALDA System outputs, and how is the summary employed in maintenance decision-making?

The information derived from the study is intended to convey the typical impact on user personnel and squadron maintenance management decisions.

Information will be provided concerning the background and purpose of the two information systems involved, 3-M and NALDA. Because the possibilities for discussion of the two systems is so broad, the background and related information are limited to a general overview so that the reader can acquire an understanding of their purpose and sources.

The thesis will propose recommendations to:

- Improve decision-making support to the squadron maintenance user.
- Suggest other areas regarding the Aviation 3-M and NALDA Systems for further study.

This study was motivated by the interest of the Navy Aviation Supply Office in the extent and usage of outputs from the 3-M and NALDA systems, especially by management involved in the merger of the systems' databases. The study was also motivated by an interest in how 3-M information is utilized by squadron maintenance and by whom.

II. OVERVIEW OF AVIATION 3-M

Prior to the 1960's, definitive data regarding Navy aircraft operational, maintenance, and logistics support were mostly limited to squadron levels of management. Only a few up-line reports, mainly concerning aviation maintenance and operations fleet-wide, were produced and made available to Navy commands. [Ref. 1:p. 9]

Beginning in the middle 1960's, the Navy began to distribute aggregated maintenance management and logistical support information to all levels of the naval aviation community. Standard procedures were developed and instituted Navy-wide to collect the data to support this goal. From this was born the Navy Aviation Maintenance and Material Management (3-M) System. Officially implemented in January, 1965 the Aviation 3-M System was designed to provide Naval staff managers and support personnel with data about maintenance and logistics efforts in the Navy aviation community. Local managers, such as those at the squadrons, were only to be provided with short-term historical data for trend analysis. However, the eventual goal was to provide timely and accurate maintenance and logistics information to all levels of Navy management, including the squadrons. [Ref. 1:p. 10]

A. ORGANIZATIONAL LEVEL 3-M

The Aviation 3-M System functions as an integrated system consisting of two parts: the Planned Maintenance System (PMS) and the Maintenance Data

System (MDS). PMS provides for the systemized conduct of preventative aircraft maintenance. It specifies what inspections have to be performed, when, how, the skills - tools - special equipment required, safety precautions to be followed and the sequence in which the inspection actions should be accomplished. [Ref. 4:p. 2]

The Maintenance Data System (MDS) provides for the collection and processing of statistical data essential to the efficient management of maintenance organizations [Ref. 5:p. 2-1]. The data gathered and processed by the system are used to provide the following information:

- Equipment maintainability and reliability.
- Equipment configuration, including alteration and technical directive status.
- Equipment mission capability and utilization.
- Material usage.
- Material nonavailability.
- Maintenance and material processing times.
- Weapon system and maintenance material costing.

The MDS system consists of four subsystems:

- Maintenance Data Reporting.
- Material Reporting.
- Subsystem Capability Impact Reporting (SCIR).
- Utilization Reporting.

In Maintenance Data Reporting, reports are generated from work center source documents that enable maintenance managers to track the nature, quantity and quality of aviation maintenance work. The Material Reporting subsystem generates reports that monitor the flow of repairable components at the local supply level. SCIR provides data to determine mission capability, system or subsystem reliability and serves as a management tool. Utilization Reporting tracks the use of aircraft and training devices by a squadron.

B. FLOW AND PROCESSING

1. Three Cycles Of Data Flow

Figure IIa on the following page presents the flow of aviation 3-M data from the squadron to its eventual output as processed information.

OPNAVINST 4790.2E [Ref. 5] considers the 3-M data flow as consisting of three cycles:

- The local cycle, consisting of the Organizational and Intermediate maintenance levels.
- The local-central cycle, between a local activity, such as a ship or station and the Naval Aviation Maintenance Support Office (NAMSO).
- The central-external cycle between NAMSO and various system commands, offices/agencies and commands other than the originating command.

a. Local

At this level is found the basic source of data for the 3-M system: work center personnel. Upon completion of each maintenance job, personnel must provide completed source documents to the work center supervisor. The

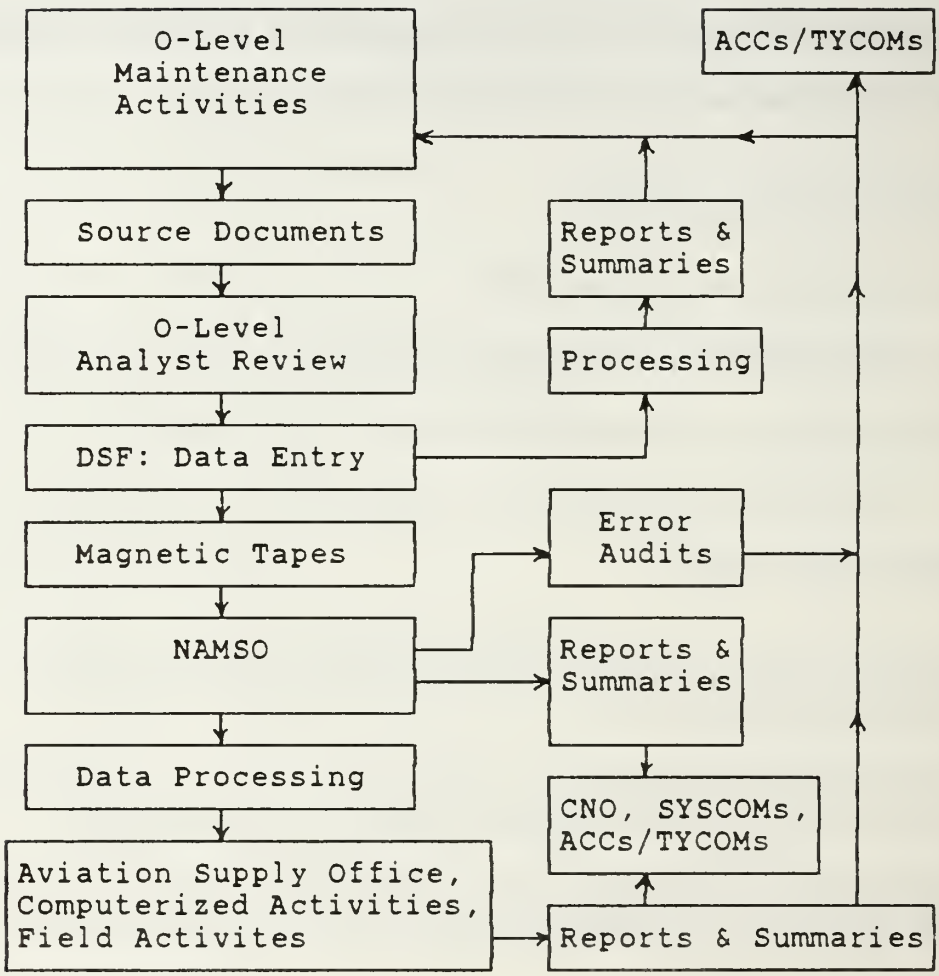

FIGURE IIa: AVIATION 3-M DATA FLOW

supervisors forward these forms via the maintenance control office to the squadron analyst. After screening the source documents for completeness and accuracy, the analyst delivers the forms to the local data services facility (DSF) where data are entered. Questionable data are referred back to the originating squadron by the DSF for correction. Entered data are converted to magnetic tapes by the DSF. Machine listings summarizing each squadron's data are printed and forwarded to the squadron for their use.

b. Local-Central

The DSF forwards magnetic tapes of the collected 3-M data to NAMSO. Here, the data from all DSFs are combined and reproduced on tapes for further processing. Machine runs for errors and processing of the aggregated 3-M data are performed. Results of the error analysis and information derived from the data processing are sent to the reporting activities, including the squadrons.

c. Central-External

The data from the central processing at NAMSO are also provided to various organizations higher in the command management chain. These include the CNO, system commands, system command field agencies, contractors and others who use such data as a basis for command and management decisions. The content and form of these reports vary according to the needs of the receiving organization/agency [Ref. 5:p. 2-10].

2. Data Processing

a. The Data Services Facility

The local data services facility (DSF) receives the source documents and converts the data contained in them into machine records. These records are then used to produce standard reports called maintenance data reports (MDRs) for the squadrons. An MDR consists of coded data elements arranged in a logical sequence. The squadron analyst decodes the elements and assembles the data for use by maintenance managers. By analyzing the uncoded data, the effects of any conditions that might be indicated can be discerned as to whether they are favorable or unfavorable [Ref. 5: p.4-1]. An example of the type of information derived from an MDR would be High Rate Failure Items.

b. Central Data Processing Facility

NAMSO, the Navy Aviation Maintenance Support Office, located at Mechanicsburg, Pennsylvania is considered the central processing facility for the Aviation 3-M System. Its primary purpose is to furnish timely, accurate and meaningful 3-M information products tailored to support all levels of Navy management [Ref. 4:p. 15]. NAMSO receives the data from the squadrons and other reporting activities via their appropriate DSF. Standard reports are prepared from the processed, aggregated data for distribution to designated and requesting activities, including aviation squadrons. The data accumulated by NAMSO pertains to all aspects of aircraft maintenance throughout the Navy.

C. APPLICATION OF PROCESSED DATA

The collection of aviation 3-M data and the machine processing performed on the data provides a database of aviation maintenance actions Navy-wide. The process of data analysis highlights significant events that might indicate the need for corrective action or command management attention. These significant events serve as the basis for decision-making by a command, such as in maintenance. To ensure that the process of data analysis continues to support command management decisions, the applicable OPNAV instruction "encourages" continuous refinement of the analysis process at all levels. [Ref. 5:p. 2-10]

III. 3-M INFORMATION OUTPUTS

This chapter examines the three areas of specific focus in this study:

- The squadron-generated monthly 3-M summary in the format as suggested by OPNAV instruction.
- Aviation 3-M information reports from NAMSO (Naval Aviation Maintenance Support Office).
- Information outputs from the Naval Aviation Logistics Data Analysis (NALDA) System. Since NALDA does not presently produce any reports directly for the squadrons except upon request, the purpose and extent of information and reports available from the system are the focus here.

A. INTERNAL AVIATION 3-M PRODUCTS

The Maintenance Data System (MDS) of the Aviation 3-M System is designed to accumulate data pertaining to all phases of maintenance. OPNAVINST 4790.2E [Ref. 5] provides guidance as to the methods for the extraction, examination and presentation of pertinent data. The results derived from analysis are intended to assist a maintenance manager in the effective use of his or her resources in the squadron. Favorable and unfavorable trends should be exposed by the analysis. Since the command is responsible for resolving problems resulting from unfavorable maintenance procedures, it is to the benefit of the maintenance manager to use sources that reveal such conditions. [Ref. 5: p. 4-1]

Analysis may be initiated in response to a specific problem, or to study selected areas of maintenance. Once a subject has been chosen, then the data required for the analysis must be selected. There are no standards to guide data selection; it is up to the assigned person doing the analysis. The intent of an analysis is to:

- Determine if a problem exists.
- Identify factors contributing to a problem.
- Compose a list of conclusions.
- Suggest alternative courses of action. [Ref. 5:p. 4-2]

Any decision based on the resulting report would be the responsibility of a maintenance manager. One way that a squadron can monitor its maintenance activities is to produce a monthly maintenance summary.

1. Monthly Maintenance Summaries

A widely accepted method of publishing results of maintenance analysis is in the form of a monthly summary [Ref. 5:p. 4-23]. There is no set format by which a monthly maintenance summary should be done. The applicable OPNAV instruction recommends that the summary contents and format be based on what squadron management wants to know. These "requirements" may include, but are not limited to, the following:

- Efficiency of maintenance operations.
- Direct support cost per flight hour, per sortie, or departure, as desired.

- High man-hour consumers.
- High failure rate components.
- Mission capability.

Distribution of the monthly maintenance summary is recommended for all work centers and interested parties within the squadron [Ref. 5:p. 4-24]. Higher level commands, such as the Functional Wing, may also desire to receive maintenance summaries prepared by subordinate squadrons to monitor their performance and problem areas.

2. Other Information Products

Additional information useful to the maintenance manager can be derived from Maintenance Data Reports (MDRs), Naval Flight Record (NAVFLIR) Subsystem, and Subsystem Capability Impact Reporting (SCIR) reports and documents. Using source documents and reports and the methods described in OPNAVINST 4790.2E, Volume V [Ref. 5], the following can be calculated:

- Computation of job averages: the number of man-hours expended to accomplish a specific job.
- Identification of high man-hour, maintenance action and failure rate items: used to highlight improper maintenance practices, material deficiencies or lack of technical proficiency.
- Control charts: determine reliability of components subcomponents by comparing the number of failures for a specific part to a computed control limit. Among the more important of these is the Cannibalization Trend Chart and Summary. These note a realized shortage of parts and man-hours incurred in removing or replacing cannibalized parts.

- Maintenance man-hours by aircraft bureau number: indicates which aircraft required high amounts of direct maintenance man-hours and the type of maintenance performed.

- Maintenance man-hours per flight hour and sortie: developed to track labor expended for individual work centers or an entire maintenance department.

- Mission capability: expressed in either sorties, departures or flight hours.

- Awaiting Maintenance (AWM) Reason Code Summary: provides a manager with an overall picture of where, how much time and for what reason something had to wait for maintenance.

- High Five EOC Degradation by Mission Capability Category: presents the five highest equipment operational capability (EOC) degradation by mission capability category.

B. EXTERNALLY-PRODUCED INFORMATION PRODUCTS

1. Naval Aviation Maintenance Support Office

The Naval Aviation Maintenance Support Office (NAMSO) serves as a central data bank for aviation 3-M data. NAMSO uses 3-M data to produce its Management Information Reports which are distributed throughout the Navy. A catalog of those reports is available to most commands upon request. [Ref. 6:p. 1]

There are six categories of reports offered by NAMSO:

- AIMD Repairable Components and Supply Parts.

- Administrative.

- Reliability and Maintainability.

- Data Monitoring.

- Equipment Mission Capability and Utilization.

- Support and Services.

Depending on the specific report, the data contained therein can be arranged by work center or record type.

One report issued monthly to all squadrons is the NAMSO Monthly Error Report (NAMSO 4790.A7212-01). This report shows the results of input data validation from the squadron. When the data received do not meet prescribed standards, the entire record is printed in the detailed error listing and the erroneous elements are flagged. Maintenance personnel should use the report to determine why the flagged data are invalid and take corrective action to prevent a recurrence. A principal benefit of this report is that it can be used to pinpoint weaknesses in the squadron's 3-M documentation efforts. [Ref. 5:p. 2-17]

Due to the number of Management Information Reports available, and since the type and number of reports may differ from squadron to squadron, a general listing is not provided here. However, those reports received at the squadron level will be described in chapter five.

2. Naval Aviation Logistics Data Analysis System

The Naval Aviation Logistics Data Analysis (NALDA) System is a management information system designed to assist users in making better decisions about Navy aircraft readiness through aviation logistics management and technical decision support. Operating as an automated database and information retrieval system, NALDA provides analysis capability through interactive query and batch processing from remote terminals. Processed 3-M data from NAMSO

comprises an estimated 30% of the database, which is an aggregate of logistics information from aviation activities [Ref. 3].

NALDA evolved from a need for improved data analysis capabilities to support fleet aviation weapon systems management and became operational in the early 1980s. The general purposes of the system are:

- Aviation maintenance/logistics historical data.
- Standardized analysis techniques and procedures.
- Configuration management and tracking capabilities.
- Standardized, aviation community MIS support.
- Telecommunications access to information systems throughout the Department of Defense.

As originally envisioned, system accessibility was planned for the intermediate maintenance level and above. Today, most Functional Wing commands have NALDA dedicated terminals with indirect accessibility available to squadrons. However, installation and direct accessibility to the squadrons themselves is not planned at this time. [Ref. 3]

The broad range of capabilities provided by NALDA which are applicable to the squadron level include: repair and performance evaluations; long-term trends; problem analysis; scheduled maintenance requirements; maintenance planning factors; and life-limited component tracking. A sampling of accessible databases, applications and reports follow:

- Aviation 3-M/Equipment Summary Reports.
- Analytical Maintenance Program Analysis Support System.
- Organizational Maintenance Activity Analysis System.
- Individual Component Repair List Database.
- Last Engine Transaction Report.

NALDA can develop unique applications and customized reports for a requesting activity.

The host computer system that provides this database technology and real-time interaction is located at the Aviation Supply Office, Philadelphia. The use of the term "real-time" refers to the latest data, which with the 3-M data can be 60-90 days behind the current time period.

Use of NALDA can be limited by two factors: turnover of trained operators and lack of knowledge about the system and its capabilities. Training is formally provided only three times per year, once on the West Coast and twice on the East Coast. Informal training is provided as funding permits. With the turnover/transfer cycle of Navy personnel, accessibility to NALDA by lower-level commands may be limited by lack of trained personnel. In addition, it is estimated that only 15-20% of the LDOs and Warrant Officers who currently fill critical roles in Navy aviation maintenance are knowledgeable of the system's existence [Ref. 3]. Despite these factors, NALDA is slated for further expansion of its database content that will allow it to support additional logistics elements and expand its accessibility.

IV. METHODOLOGY

The principal method this thesis used to collect data was a survey of organizational level aviation maintenance in the Navy. The focus was the use of certain information outputs derived from the Aviation 3-M System. This chapter examines the survey type, selection of survey participants and squadrons, background sources and analysis of the data collected.

A. SURVEY DISCUSSION

1. Selection Of Survey Type

Three methods were considered for performing the survey: face-to-face interviews; a telephone survey; and a mail questionnaire. The face-to-face interview was selected as being most appropriate to this project because:

- Such interviews tend to be less rushed than other methods, thus making the interviewer feel more free to probe. This was important since the primary interview subjects were enlisted personnel who might not be as free with their answers otherwise.
- Interviews are less likely to be turned down when compared to other methods.
- The order and conduct of questioning can be controlled.
- This method has more options regarding a possible line of questioning than any other method.
- The interviewer can actually see the support materials or end products that the subject is using/producing.

- Follow-up interviews can be conducted in the same activity with other personnel who might otherwise not be available or would refuse. [Ref. 7: p. 203]

In considering a telephone survey, there are disadvantages that can affect the quality of any information derived. Disadvantages noted by Viladas [Ref. 7] include the factor of time and the pressure it may place for completion of a telephone interview within a limited period. Long and complex questions can become difficult to administer. The disadvantage of the interview being "impersonal" might restrict the subject answers to answering only directly with no expounding upon the answer. [Ref. 7:p. 207]

Mail surveys have advantages in cost compared to other methods. However, this method limits the ability of an interviewer to probe for deeper answers to open-ended questions. It is far easier to leave a mail questionnaire unanswered than to say "no" to an interviewer. Finally, it is much more difficult to conduct follow-up interviews with other personnel in the squadrons who might be able to provide further insight into initial data gathered in the first interviews. [Ref. 7: p. 211]

2. Interview Technique

Face-to-face interviews consist of two types, with or without a fully-developed questionnaire. Interviews without a questionnaire are useful for exploratory interviews when searching for ideas or trying to understand how people think or talk about something the interviewer wants to examine [Ref. 7: p. 219]. An example is using this technique for interviewing specialists, as the

people interviewed in this study were considered to be. Therefore, it was this type of interview that was selected.

To help conduct the interviews, a semi-structured guide consisting of the following questions was developed, to be asked in the order noted:

- How is aviation 3-M data input by a squadron?
- To whom does the data go?
- What outputs are received from NAMSO and the NALDA System and how are they used?
- How are internally generated reports derived from the squadron's 3-M inputs and used?
- What additional information occasionally required by higher authority can be derived from them?
- What other sources of 3-M derived information are typically received or requested by a squadron? Source(s)? Use(s)?
- What suggestions can be made for improvements to existing reports received from organizations such as NAMSO?
- What additional information can be derived from aviation 3-M data that would be useful to squadron maintenance?

The questions were selected on the basis of the topics discussed in Chapter I.

B. INTERVIEW PARTICIPANTS

1. Primary

According to the applicable OPNAV instruction [Ref. 5], the Quality Assurance Analyst is tasked to provide qualitative and quantitative analytical information to the Maintenance Officer (MO) to enable continual review of

management practices within the maintenance shops or work centers. The Analyst is responsible for the management of all aspects of the Maintenance Data System (MDS) in the work centers. The MDS includes the 3-M system. In addition, the Analyst serves as the contact point between the work centers and the Data Services Facility (DSF). The QA Analyst is usually a senior petty officer, formally trained in MDS procedures, data processing capabilities and the techniques of statistical analysis.

One duty assigned to the Analyst is to collect, screen and forward all MDS source documents to the DSF for processing and to ensure that completed reports are picked up and disseminated throughout the reporting activity. Furthermore, the Analyst has technical functions to be performed with the 3-M data:

- To collect, maintain, and distribute in narrative, tabular, chart, or graph form the data required to monitor, plan, schedule, and control the maintenance effort.
- To identify and apply analytical techniques to areas of material deficiencies, high man-hour consumption, or other pertinent trends.
- To provide assistance to maintenance/material control in contents of monthly MDS reports for material consumption and projected material usage. [Ref. 5:p. 2-11]

It is the QA Analyst, then, who reviews the aviation 3-M forms before they are forwarded for keypunching, and who reviews and disseminates the data reports from the DSF. Also, the Analyst serves a primary role in discerning trends or similar from 3-M derived information. Therefore, the QA Analyst was chosen as the primary subject for the interviews.

2. Secondary

Additional interviews, if and when needed, were conducted with managerial personnel in maintenance. Because of the routing of information disseminated by the Analyst, these additional personnel were usually the QA Chief Petty Officer, QA Division Officer, Maintenance/ Material Control Officer, Assistant Maintenance Officer and/or Maintenance Officer. Because of the duties assigned to these personnel, they are most likely to have an effect on the decision-making in maintenance.

The questions concerned the use of information derived from reports generated and/or forwarded by the Analyst based on aviation 3-M information outputs.

C. SELECTION OF SQUADRONS

An extract of twelve squadrons from the Atlantic and Pacific Fleets were selected for the survey. Travel funding plus the time required for the interviews limited the number of squadrons that could be visited.

The squadrons included in the survey flew helicopters, jets, and propeller type aircraft. This allowed for comparisons of responses between squadrons according to aircraft type.

Both regular fleet and training squadrons were included in this survey. This was done to discern any differences in the use and types of 3-M outputs between those two types of squadrons.

Anonymity for Analysts and the squadrons was given to enhance accuracy and honesty in the interviews.

D. BACKGROUND RESEARCH

Because this study aimed to provide a better understanding of the Aviation 3-M and NALDA Systems, interviews were also conducted with personnel at the Aviation Supply Office in Philadelphia and the NALDA System at NAS Patuxent River, Maryland. These interviews focused mainly on data processing and further uses derived after that processing, both to ASO and the lower-level user in organizational maintenance.

Another source of information came from interviews held with Functional Wing Data Analysts in the upper level chain-of-command for each squadron interviewed. The purpose for this was to highlight requirements made by each Wing on its squadrons about 3-M data. Also probed was the use of the NALDA system at the Wing level. These interviews were meant to highlight any guidance provided to the squadrons for the generation of internal 3-M related reports. Lastly, the use of reports from organizations such as NAMSO were noted and examined.

E. ANALYSIS OF DATA

One justification made for maintaining the setup required to collect the 3-M data and process it, along with the costs involved, is for its use at all levels of command management [Ref. 5:p. 2-10]. The processing provides management with "significant" facts as a basis for decision making. Organizational level

maintenance is specifically mentioned as being one of those management levels. Improvements to the data analysis process are essential to system improvement, leading to better outputs for the squadron customer. Considering how and to what degree 3-M related outputs are used by a squadron's maintenance may provide impetus to such improvements.

The interviews with the squadron Analysts were analyzed for the following:

- Comparison of 3-M information outputs from NAMSO and the NALDA System received by the squadron and routed to the Analyst.

Included were the source of the report, report number, how the report was used by the Analyst and others in Maintenance, and general feedback by the Analyst regarding the report(s).

- Comparison of internally generated squadron monthly 3-M summaries.

Included were sources for the report, guidelines for the report and their source, topic areas covered, and use within each squadron. The reports were compared for differences and similarities between squadrons in general, both in content and usage. Comparison was also done between aircraft communities for the purpose of noting differences between the communities of different aircraft. Last, reports from squadrons on the East Coast were compared to those of squadrons on the West Coast to note any differences between aviation commands on the two coasts.

V. FINDINGS

The focus of this investigation was aviation 3-M information products received or produced and maintained by a squadron analyst. Of specific interest were squadron monthly 3-M summaries, NAMSO reports and any information outputs from the NALDA System. Classified reports were sometimes found to be stored by the squadron operations department, which usually had the certified containers for classified materials. Principal among such reports were those that made comparisons with other squadrons in the Pacific and Atlantic fleets.

A. NAMSO REPORTS

1. Survey Results

Table 5a on the next two pages shows the individual NAMSO reports received by each squadron. The squadrons are identified by number and separated by the coast on which located. The number identifying the squadron is the same throughout the text.

A description of those reports is provided below. The description is similar to that as provided in the Naval Sea Logistics Center catalog [Ref. 6] listing the standard NAMSO reports available for distribution.

- NAMSO 4790.A7005-10 SCIR Documentation Analysis Summary

Published monthly, this report portrays the volume of certain maintenance documents being processed. The report also identifies those

NAMSO REPORT #	SQUADRONS: EAST COAST 1	2	3	4	5	6	Sub-total
4790.A7005-10	X						1
4790.A7044-01						X	1
4790.A7092-06						X	1
4790.A7107-01							0
4790.A7212-01	X	X	X	X	X	X	6
4790.A7245-01							0
4790.A7707-04			X				1
4790.A7936-01		X		X	X	X	4
4790.A8363-01							0
4790.A8448-01							0

TABLE 5a: NAMSO REPORTS BY SQUADRON

NAMSO REPORT #	SQUADRONS: WEST COAST 7	8	9	10	11	12	Totals
4790.A7005-10							1
4790.A7044-01							1
4790.A7092-06							1
4790.A7107-01		X					1
4790.A7212-01	X	X	X	X	X	X	12
4790.A7245-01		X					1
4790.A7707-04			X				2
4790.A7936-01	X	X	X	X	X	X	10
4790.A8363-01			X				1
4790.A8448-01			X				1

TABLE 5a: NAMSO REPORTS BY SQUADRON (cont.)

documents containing subsystem capability impact report (SCIR) data. It reflects the total beginning-of-month and end-of-month documents originating at an activity and provides statistics on five major error conditions.

- NAMSO 4790.A7044-01 Detail/79 Record Comparison Summary

Published monthly, this CONFIDENTIAL report details such data as mission-capable hours, aircraft use and aircraft inventory status at the end of the month by aircraft bureau number and reporting activity.

- NAMSO 4790.A7092-06 3-M Aviation Inventory Transaction Errors

Published monthly, this report provides a list of errors encountered in the inventory processing trail as submitted to NAMSO in the Aviation 3-M System. The errors are listed by major command, aircraft, aircraft reporting custodian (activity) and bureau/serial number.

- NAMSO 4790.A7107-01 Fleet Failure Summary By Type Equipment And Work Unit Code

Published monthly, this report provides the following information on aircraft by type and major command/Navy: failure history for each item with two or more failures reported during a report month; 12 month history for trend analysis; and component failure rates compared to flight and flight hour base. The information is meant to enable analysts to readily detect problem areas and institute appropriate corrective action.

- NAMSO 4790.A7212-01 Error Statistics And Trend Analysis

Published monthly, this report provides details of what prevented certain data records from passing the 3-M aviation MDS validation specifications.

- NAMSO 4790.A7245-01 3-M Aviation Component Repair Report

Published quarterly, this report depicts information for the previous six months on repairable components processed through intermediate level maintenance activities by specified codes and part number. A main item of interest is the average man-hour expenditure at the organizational and intermediate maintenance levels.

- NAMSO 4790.A7707-04 Type Equipment/Work Unit Code To Part Number Cross Reference Listing

Published monthly, this report reflects the number of failed parts, repair items, beyond capability of maintenance (BCM) items, no defect items and the total items processed through an intermediate level maintenance activity.

- NAMSO 4790.A7936-01 3-M Aviation Information Digest Aid

Published monthly, this report provides comparative information concerning SCIR, usage and various maintenance efforts on selected aircraft. The report also serves as a guide in identifying potential trouble areas leading to a more detailed study using other aviation 3-M reports and sources of information.

- NAMSO 4790.A8363-01 Equipment Degradation Ranking Summary

Published monthly, this report identifies for the previous three months the high items which affect equipment full-mission-capability and highlights those areas where corrective action is critical.

- NAMSO 4790.A8448-01 Aircraft Intermediate Maintenance Department Production History Summary

Published quarterly, this report provides information concerning the production and capability of the various aircraft intermediate maintenance activities. Identifying the repairable component by part number and work unit code, this report includes: average man-hours and elapsed maintenance time; average turn-around-time; mean flight hours between failure; and items processed.

2. Usage

The Error Report (NAMSO 4790.A7212-01) and The Digest Aid (NAMSO 4790.A7936-01) were used by the squadrons for some trend analyses and comparisons. No other report was noted for any specific or general use. All reports were being received at the time that the analyst assumed his/her job.

3. Squadron Comments

The personnel who were interviewed noted several areas for comments:

- Time lag of information

The dated nature of the information in NAMSO reports limited their use. That lag made detecting problems at the squadron level through NAMSO reports almost useless. Historical data, when required for whatever reason, was drawn from the squadron's own files/records because it was more current.

- Ease of use

Experience was noted by some analysts as being a factor in their ability to derive information in a reasonable amount of time from the NAMSO reports. One analyst who did not know how to get the information that he needed from a report had to request the information from the Functional Wing analyst.

- Quality

Four analysts considered the data quality as good. One analyst did question the quality because of personal experience and knowledge of the number of keypunch errors committed while entering the source data. No other analysts specifically mentioned quality.

- Readability

Improvement in this area was mentioned by two analysts.

- Accessibility

Faster accessibility to NAMSO reports or data might improve squadron use, according to six analysts. Three suggested direct access of the NAMSO database by a squadron personal computer. Three stated that real-time access itself would help, by whatever means available.

4. Functional Wing Comments

Five Wing data analyst departments that were interviewed mentioned these areas regarding NAMSO reports:

- Quality

Analysts at two of the Wings questioned the quality of the data in the reports. However, one analyst thought the quality was good. The analysts at the other two Wings had no comment.

- Time lag of data

The 60-90 days age of the reports did not aid in solving any of the real-time problems faced by one Wing or its squadrons, according to its analyst. Also, the derivation of data from the reports was time consuming.

- Use of reports

Trends and comparisons were the only uses specifically mentioned, mostly concerning West Coast versus the East Coast.

B. NALDA SYSTEM

1. Survey Results And Discussion

Table 5b on the following page presents NALDA usage by squadron as derived from the survey. The squadrons are identified by number and separated by the coast on which located. The number identifying the squadron is the same number as that used throughout the text.

Also noted from the survey were the following:

- Frequency Of Use

The heaviest user of NALDA made 2-3 requests per quarter; the least frequent user made 2-3 requests per year.

- System Access

Squadrons requiring NALDA-derived information routed requests through their respective Functional Wing. Four of the five wings that had cognizance over the squadrons in the survey had terminals dedicated to NALDA and trained personnel to operate the terminals. The squadrons under the one Wing without direct access routed their inquiries through the Wing to the Type Commander.

In general, East Coast squadrons used the system more and had greater knowledge of the information available through NALDA than squadrons based on the West Coast.

USE	SQUADRONS East Coast 1	2	3	4	5	6	West Coast 7-12
None; no knowledge	X					X	
None but knowledgeable				X			X
Component/aircraft history		X					
Input/output reports for A-799s		X					
Individual cannibalization actions		X					
Information unique to an aircraft by work unit code			X				
Trend analysis			X				
Special problems and needs; no specifics					X		

TABLE 5b: NALDA USE BY SQUADRON

2. Functional Wing Usage

Nalda terminals were available at four of the five Functional Wing commands supervising the twelve squadrons. There was generally at least one person trained on the system for making entries. Two of the Wings had at least three people qualified.

Use of the system centered on specific part or component information. Quality of the information received was considered good by one Wing analyst, because it could be tailored toward specific needs. Another analyst noted that the little use by squadrons in that particular Wing might be due to a lack of knowledge on the part of squadron analysts.

The amount of usage by each of the Wings was noted for only the one that did not have direct access but had to route such requests to its type commander: 2-3 inquiries per year, possibly one per quarter. Most of those requests concerned specific information on technical directives.

C. SQUADRON-GENERATED REPORTS AND SUMMARIES

1. Monthly Summaries

Four of the five Functional Wings required their squadrons to produce and forward a monthly summary of aviation 3-M information. Format and contents were set through guidance from the wings. The squadrons used the same report with some additional items as the basis for their own internal monthly 3-M summary.

a. *Contents*

Table 5c on the next four pages presents by squadron the general categories of information in each of the monthly 3-M summaries of the squadrons surveyed. When a squadron consisted of more than one type of aircraft, each aircraft was portrayed separately by category as applicable to the monthly summary. The squadrons are identified by number and separated by the coast on which located.

The core of each squadron's summary covered the following basic areas, with any differences being in the detail and titles:

- Corrosion control: man-hours and documentation, measured over a 6-12 month period.
- Direct maintenance man-hours per flight hour: covered the previous 6-12 months.
- Cannibalization data/trends: over differing time periods according to squadron needs.
- Mission capability rates: full-mission-capable (FMC), partial-mission-capable (PMC), and non-mission-capable (NMC).
- High failure/malfunction items.
- No Defect (A-799) Reports: Indicate the amount of time and effort expended on maintenance for which there is no malfunction or alleged malfunction.
- Flight activity/history: measured over a 6-12 month period.
- Man-hour documentation by work center or maintenance action.
- High man-hour consumer items: One squadron summary specified such items by three categories: aircraft, powerplants, and avionics.

GENERAL CATEGORY	SQUADRONS:EAST COAST 1	2	3	4	5	6	Sub-Total
Aircraft Readiness History	X						1
Corrosion Control	X	X	X	X	X	X	6
High Failure/ Malfunction Items	X	X			X	X	4
Direct Maintenance Man-Hour per Flight Hour	X	X		X	X	X	5
Cannibalizations	X	X	X	X	X	X	6
When Discovered History	X				X		2
Mission Capability Rates		X	X	X	X	X	5
No Defect (A-799)		X	X	X		X	4
Aircraft Abort Explanation		X	X				2

TABLE 5C: MONTHLY 3-M SUMMARIES BY CATEGORY

GENERAL CATEGORY	SQUADRONS:EAST COAST 1	2	3	4	5	6	Sub-Totals
High Man-Hour Consumers			X	X	X	X	4
Major Foreign Object Damage			X	X			2
SCIR Hours			X				
Man-Hour Documentation			X	X	X		3
Tool Control Summary			X				1
Manpower Documentation						X	1
Flight Activity/ History							0
Maintenance Documentation							0
Monthly Error Rates							0
Sortie Completion Rates							0

TABLE 5c: MONTHLY 3-M SUMMARIES BY CATEGORY (cont.)

GENERAL CATEGORY	SQUADRONS:WEST COAST 7	8	9	10	11	12	Totals
Aircraft Readiness History		X		X			3
Corrosion Control	X	X	X	X	X	X	12
High Failure/ Malfunction Items	X			X			6
Direct Maintenance Man-Hour per Flight Hour	X	X			X	X	9
Cannibalizations	X	X	X	X	X	X	12
When Discovered History							1
Mission Capability Rates	X	X			X	X	9
No Defect (A-799)	X	X	X	X		X	9
Aircraft Abort Explanation		X					3

TABLE 5c: MONTHLY 3-M SUMMARIES BY CATEGORY (cont.)

GENERAL CATEGORY	SQUADRONS:WEST COAST 7	8	9	10	11	12	Totals
High Man-Hour Consumers				X	X		6
Major Foreign Object Damage							2
SCIR Hours		X					2
Man-Hour Documentation	X	X	X	X	X		8
Tool Control Summary							1
Manpower Documentation							1
Flight Activity/ History	X	X	X	X	X		5
Maintenance Documentation		X					1
Monthly Error Rates		X				X	2
Sortie Completion Rates		X					1

TABLE 5c: MONTHLY 3-M SUMMARIES BY CATEGORY (cont.)

The most detailed summary was that of a West Coast squadron. However, East Coast squadrons seemed to have more detailed summaries on average.

b. Usage

Five areas most frequently mentioned by those personnel interviewed were: corrosion control documentation and trends, man-hour utilization per aircraft/work center/flight hour, mission capable rates, cannibalization and readiness rates. Information drawn from these categories were used for trends, problem detection, and work center production. Two squadrons used their summaries only for long-term planning.

c. Squadron Comments

Four of the twelve analysts stated that they felt the monthly summaries were underused in their particular squadrons. Two squadrons specifically noted the lack of use by branch officers. One analyst thought that might be due to the lack of training about the data in the monthly summaries. Only one squadron had any type of training for supervisors and officers on use of the summaries.

The majority of analysts used internal records as sources for their monthly summaries. This was because squadron records were the only sources of information considered close to being real-time. However, one squadron's Maintenance Control office stated that its monthly 3-M summary was not much use in daily decisions because it was not real-time.

2. Other 3-M Reports

Such reports were in addition to the monthly 3-M summary. Some were in the form of an "add-on" to the monthly summary, while others were individual reports. Special request reports consisted mainly of trends and comparisons for a system or component. Another topic recalled by an analyst concerned maintenance documentation per aircraft over a specified time period. None of the special 3-M reports were recurring.

3. Functional Wing Use And Comments

The four Functional Wing commands that required monthly 3-M summaries from the squadrons were principally interested in the following areas to some degree but not all:

- Man-hour use
- Items processed
- Mission capable rates
- Flight hours

The information derived from the summaries was used for trends and comparing squadrons, locally and fleet-wide.

The one wing command that did not require a monthly summary from its squadrons used a report from NAMSO, NAMSO 4790.A7958-01 Navy-Wide Scrubbed Data, for the information that it needed. This report provides summary mission capability and usage information by major command, aircraft, and aircraft

operating activity. It also presents information on maintenance efforts related to aircraft usage. The report is available quarterly, monthly or on-demand.

VI. CONCLUSIONS

The objective of this thesis was to gather feedback from organizational level maintenance users regarding aviation 3-M information outputs. Three questions were considered:

- Do current Aviation 3-M System information outputs from NAMSO and the NALDA System to the organizational level maintenance user at the squadron meet the intent of the 3-M system, which is supporting better management decisions?
- How are those products used by squadron maintenance and to what degree?
- To what extent is a squadron's internally generated monthly 3-M summary supported by the NAMSO and NALDA System outputs, and how is the summary employed in maintenance decision-making?

The information derived from the study was intended to show the typical impact on user personnel and squadron maintenance decisions.

A. DISCUSSION

One of the requirements for designing a management information system is understanding the environment in which a manager is operating [Ref. 1:p. 30]. In the squadrons surveyed for this study, the term constantly stressed was "real-time." Aircraft readiness is a major concern, demonstrated by the inclusion of readiness and mission capability rates in various forms in monthly 3-M summaries. According to the applicable OPNAV instruction, maintenance management can be defined as:

> The actions necessary to retain in or restore to a serviceable condition with an optimum expenditure of resources. [Ref. 5:p. 5-1]

For the maintenance manager, the concern is ensuring that aircraft are available to meet mission tasking. Thus, his or her decisions are based on available information; i.e., real-time.

Specific comments about the NAMSO reports centered on the timeliness of the information, which averaged from 60-90 days in age, according to the squadrons. The use of such dated information in real-time decisions by maintenance managers is very little, if at all. By the time the NAMSO reports are received, the problems to which the data apply have been resolved or replaced by new problems for which the data are of little help.

The age of 3-M information also affects the NALDA System. Of the squadrons that use the system, the queries most noted concerned historical data. A majority of the squadron data analysts knew about NALDA but did not use it. Their opinion is that the NALDA System is just another source of dated information whose value is questionable for the real-time decisions made by squadron maintenance.

Of the information outputs examined, the squadron monthly 3-M summary received the most use. The typical monthly 3-M summary is usually produced within 10-15 days after the end of the month, using 3-M data from squadron records and the local data services facility (DSF) summaries based on the squadron's original inputs of 3-M source documents. Though the monthly 3-M summary is still considered a historical record, the information has greater use by maintenance managers because it is viewed as being more recent and closer to

real-time. The monthly summary serves the manager better because it also more closely fulfills the two requirements of an information system: to produce the information manager needs, and to produce it when it is needed [Ref. 1:p. 64].

B. RECOMMENDATIONS

A 1973 study of the Aviation 3-M System concluded that the 3-M system may not expose any problems that are not already known to the maintenance manager [Ref. 8:p. III-29]. The research for this study found that to still be a valid conclusion. NAMSO reports and NALDA information contribute little to improved management at the organizational level. The central need, as expressed in the 1973 study [Ref. 8], is data access for the squadrons which approaches real-time.

The flow of information through the 3-M system and the time required before its output as information products has an effect on its use. With the full implementation of the computer-based Naval Aviation Logistics Command Management Information System (NALCOMIS), this may provide more of the on-line real-time management information desired by organizational level managers. However, the data analysts have a "wait and see" attitude about NALCOMIS, since the system is still in the early stage of implementation in the squadrons for use with 3-M data. This writer echoes the opinion of another study, which is that present 3-M data is timely only where it is extracted and compiled at the squadron, not after [Ref. 8:p. III-28]. Therefore, an area for further study would be the broad subject of improving the real-time capability of 3-M information flow at the local level.

This study examined the organizational level maintenance use of 3-M information. Since the outputs from the NALDA System were designed for use at higher levels of management, consideration should be given to use of 3-M information outputs at the intermediate maintenance level and above. The objective, as in this study, would focus on the information outputs' capability in meeting higher level users' needs.

C. SUMMARY

It has been shown in this thesis that 3-M information outputs from NAMSO and the NALDA System do not have much impact on decision making in organizational level maintenance. The principal reason is because the information outputs are not considered close enough to real-time, the realm in which the squadron maintenance manager makes the majority of his or her decisions. The use of squadron monthly 3-M summaries is more widespread, because the information presented in the summary is more recent and, therefore, more timely. The historical nature of other 3-M information outputs makes them useful mainly as historical records for trend analysis and comparisons.

To ensure that an information system meets the manager's needs, the information must be available when a decision is being made [Ref. 1:p. 67]. At the organizational level, the use of 3-M information outputs will remain limited until the lag in the age of the information derived from the data is reduced or eliminated.

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